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science for a changing world

Continuous Real-Time Water Quality and Water Quantity Data – The Sentry Gage Program

Indiana Water Science Center

U.S. Department of the Interior
U.S. Geological Survey

Nutrient enrichment and harmful algal blooms

Erosion and sediment transport and accumulation

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Water Quality and Water Quantity

- Water-quality and ecosystems health:
  - Suspended sediment
  - Nitrogen
  - Phosphorus
- Concentrations from point sources and nonpoint sources – permit limits or criteria
- Streamflow – water quantity
- Stream loads (mass/time, lbs per day) and watershed yields (lbs per day per sq mile)

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Traditional Approach to Water Quality

- Water samples collected manually and analyzed at the laboratory, data reported, and distributed in paper and web-based formats
- Time delay between sampling and data report
- Difficult to represent entire range of potential concentrations, especially high flow events
- Night sampling and storm sampling risks
- Travel distance for sampling crews
- Resource limitations on number of samples

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The Sentry Gage Program: continuous, real-time, web-accessible data 24 / 7 / 365

- Water quantity streamflow gage with continuous water-quality sensors/analyzers and telemetry, representative sampling, and surrogate modeling.
- Suspended sediment, nitrogen, and phosphorus concentrations and loads, plus water-quality characteristics (dissolved oxygen, pH, temperature, specific conductance, turbidity)

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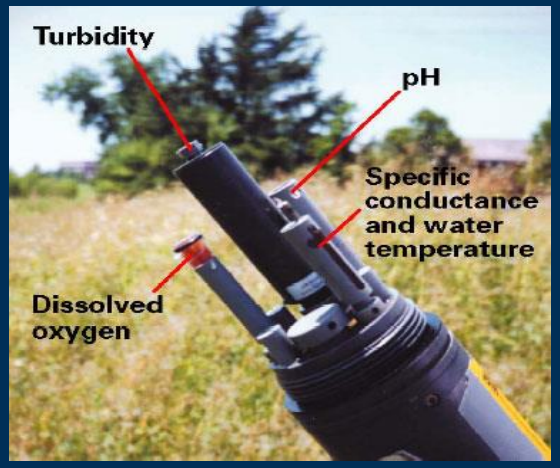
Sentry gage equipment

Data logger with telemetry and solar power



multi-parameter probes on water quality sonde

Ultraviolet nitrate sensor

automated phosphate analyzer

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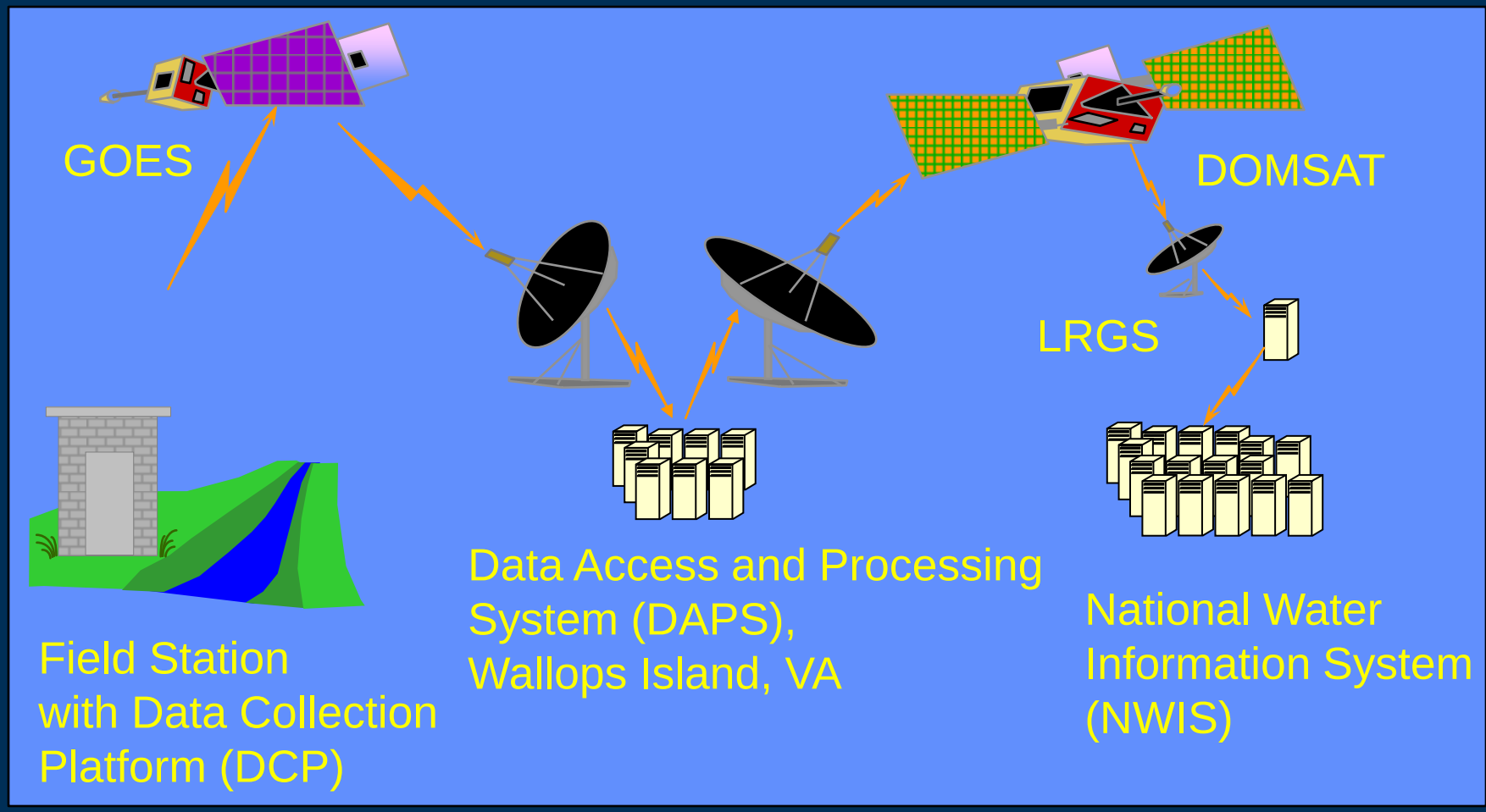
Data Transmission and Management



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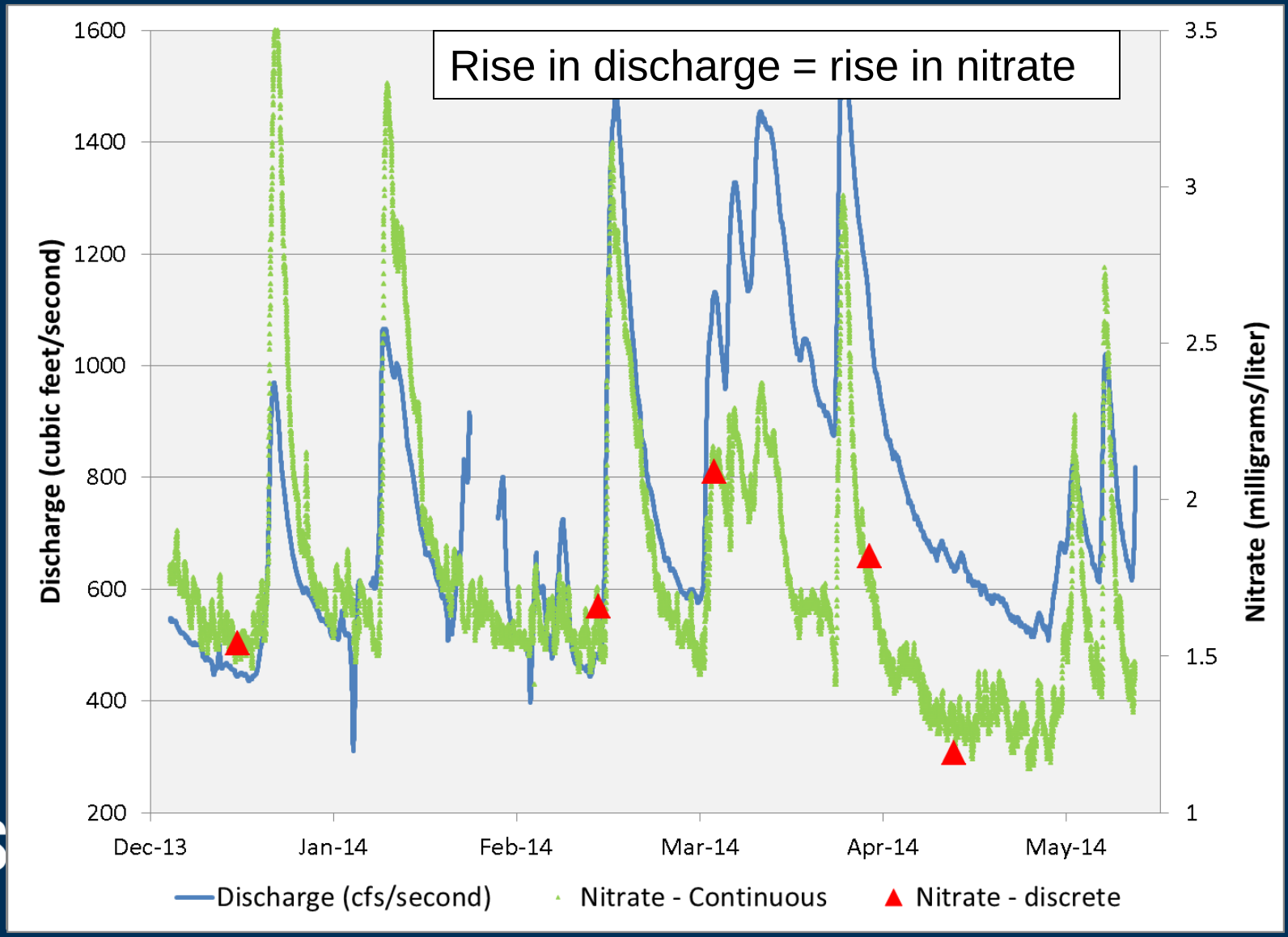
Sentry Gage on Kankakee River at Davis, IN

Nitrate –
Discrete
Continuous

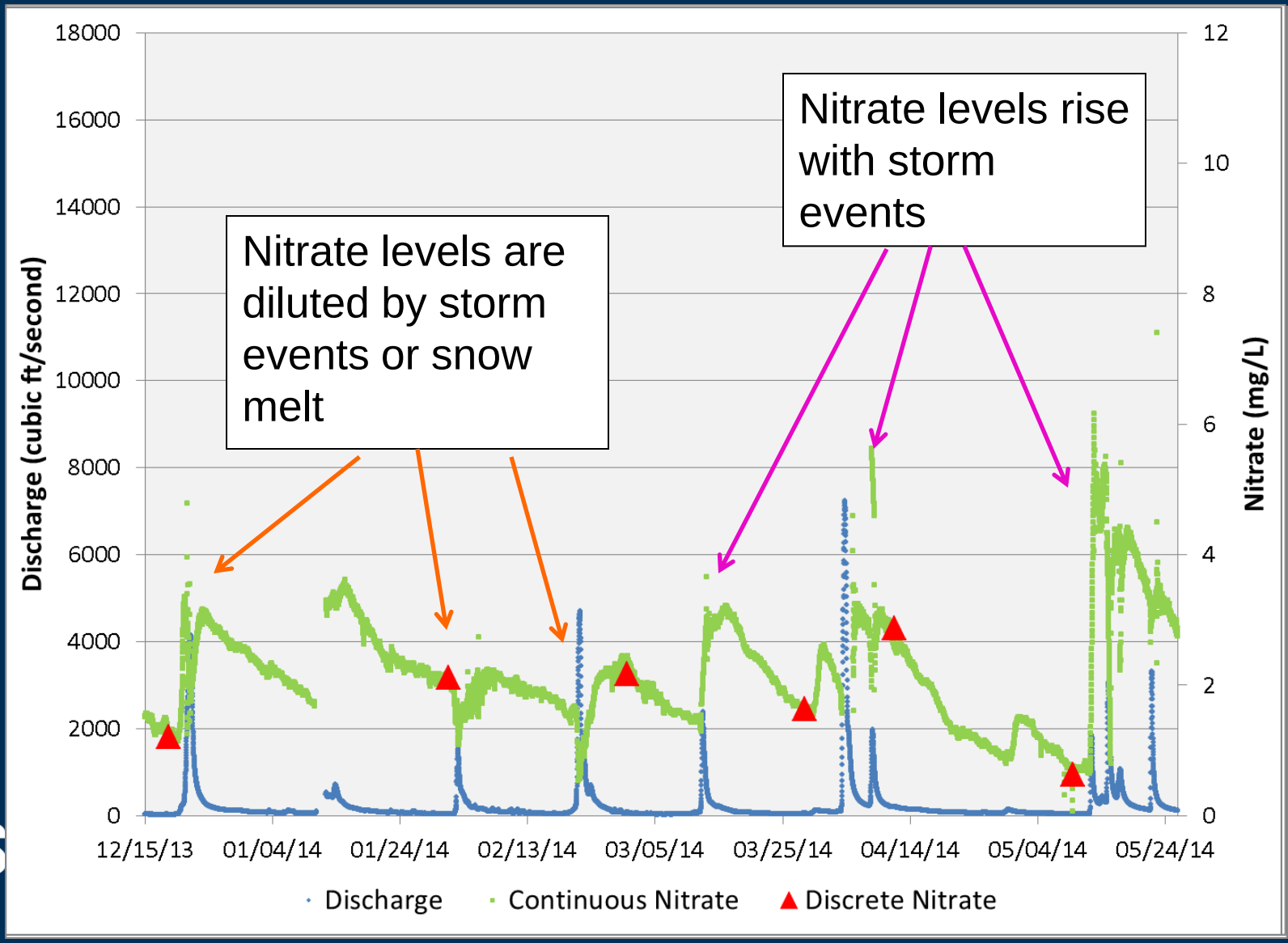
Data are provisional



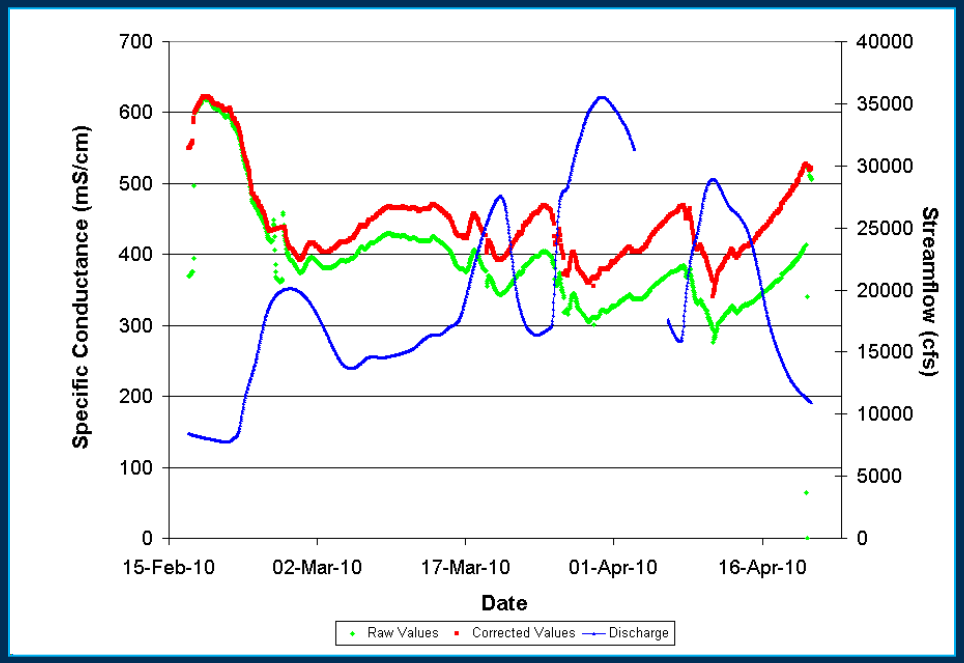
Sentry Gage on Eagle Creek at Zionsville, IN

Nitrate –
Discrete
Continuous

Data are provisional



Routine maintenance, calibration, data correction



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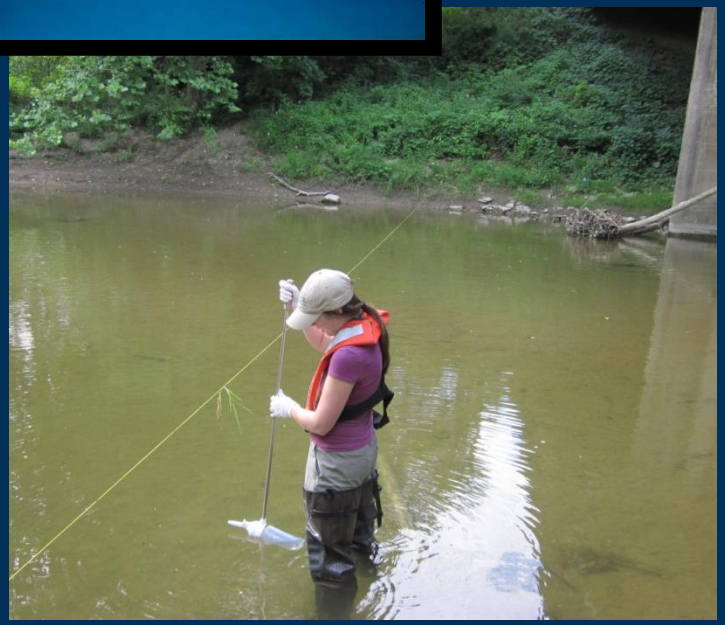
Representative sampling



Stream-width and depth-integrated water samples for laboratory analysis to verify sentry gage sensor data and for development of surrogate models

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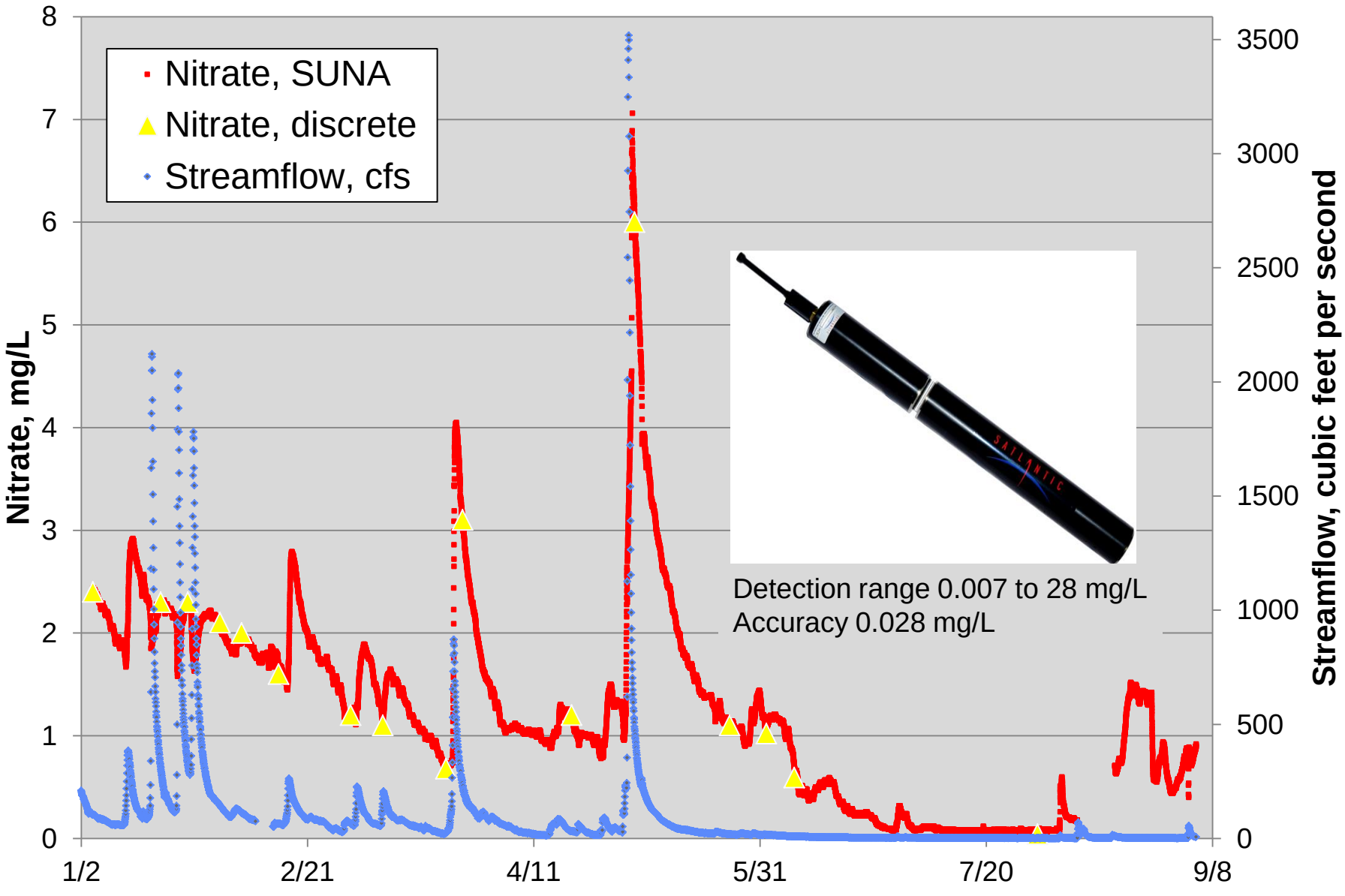
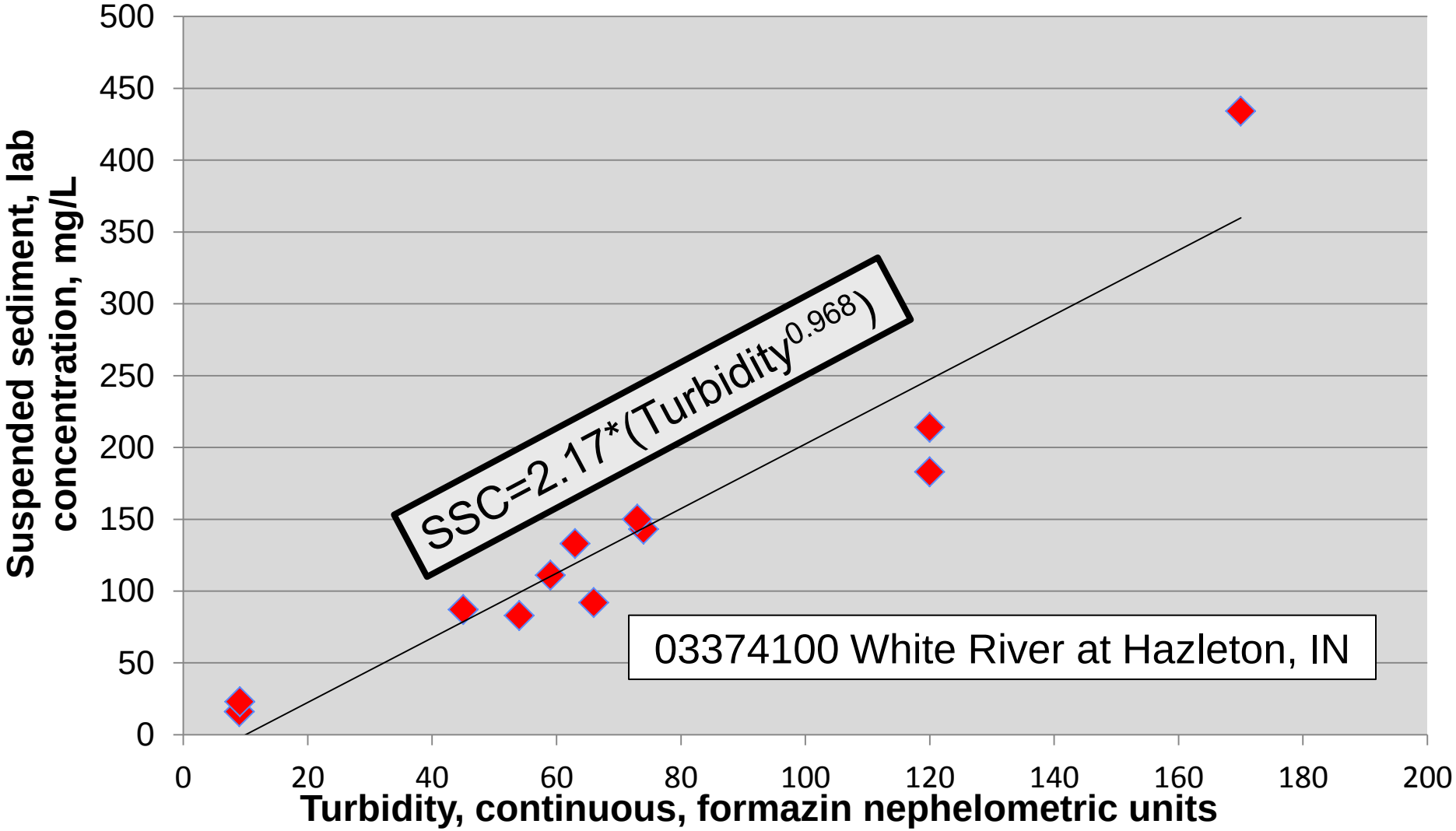
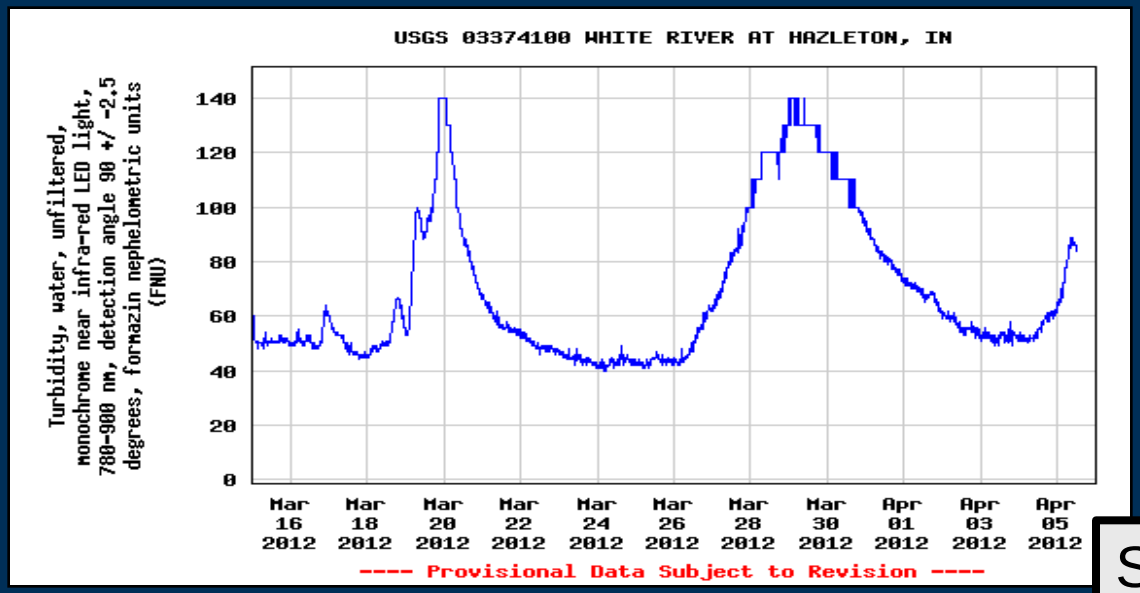
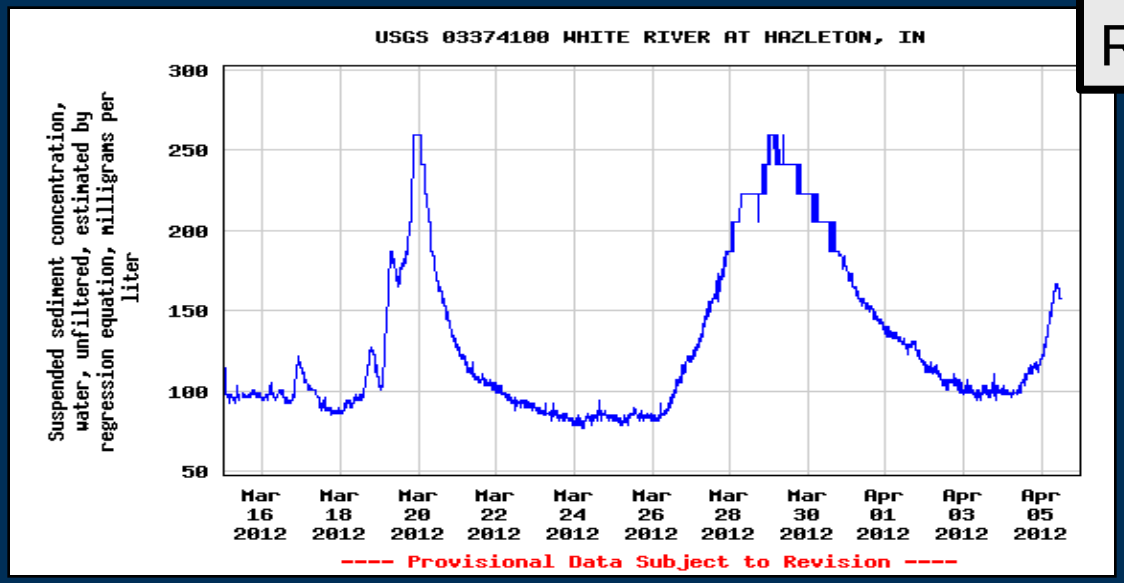

Nitrate, SUNA
Nitrate, discrete
Streamflow, cfs
Nitrate, mg/L
Streamflow, cubic feet per second
0
1
2
3
4
5
6
7
8
0
500
1000
1500
2000
2500
3000
3500
1/2
2/21
4/11
5/31
7/20
9/8
Detection range 0.007 to 28 mg/L
Accuracy 0.028 mg/L

Surrogate Model – a mathematical relation of turbidity (sensor) and suspended sediment (lab)







$SSC = 2.17 * (Turbidity^{0.968})$

$R^2 = 0.96$

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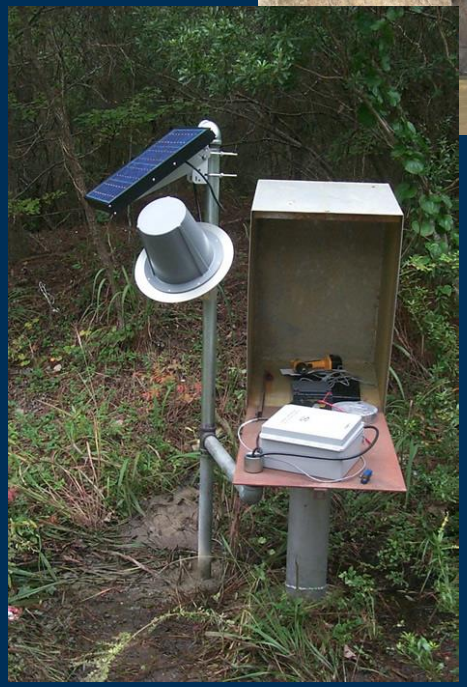
Remote-controlled autosampler



Monitoring well with telemetry

precipitation gage

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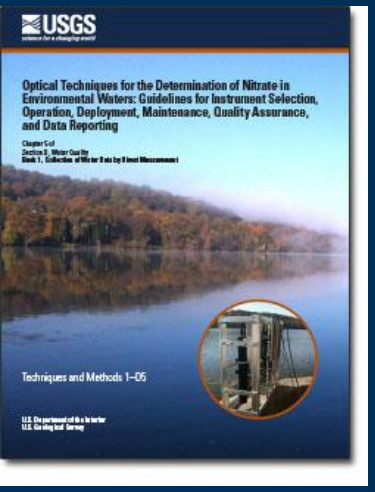
USGS Methods for Continuous Water Quality



Pellerin, B.A. Bergamaschi, B.A., Downing, B.D., Saraceno, J.F., Garrett, J.A., and Olsen, L.D., 2013, **Optical techniques for the determination of nitrate in environmental waters: Guidelines for instrument selection, operation, deployment, maintenance, quality assurance, and data reporting**: U.S. Geological Survey Techniques and Methods 1-D5, 37p.

Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, **Guidelines and standard procedures for continuous water-quality monitors – Station operation, record computation, and data reporting**: U.S. Geological Survey Techniques and Methods 1-D3, 51 p. + 8 attachments

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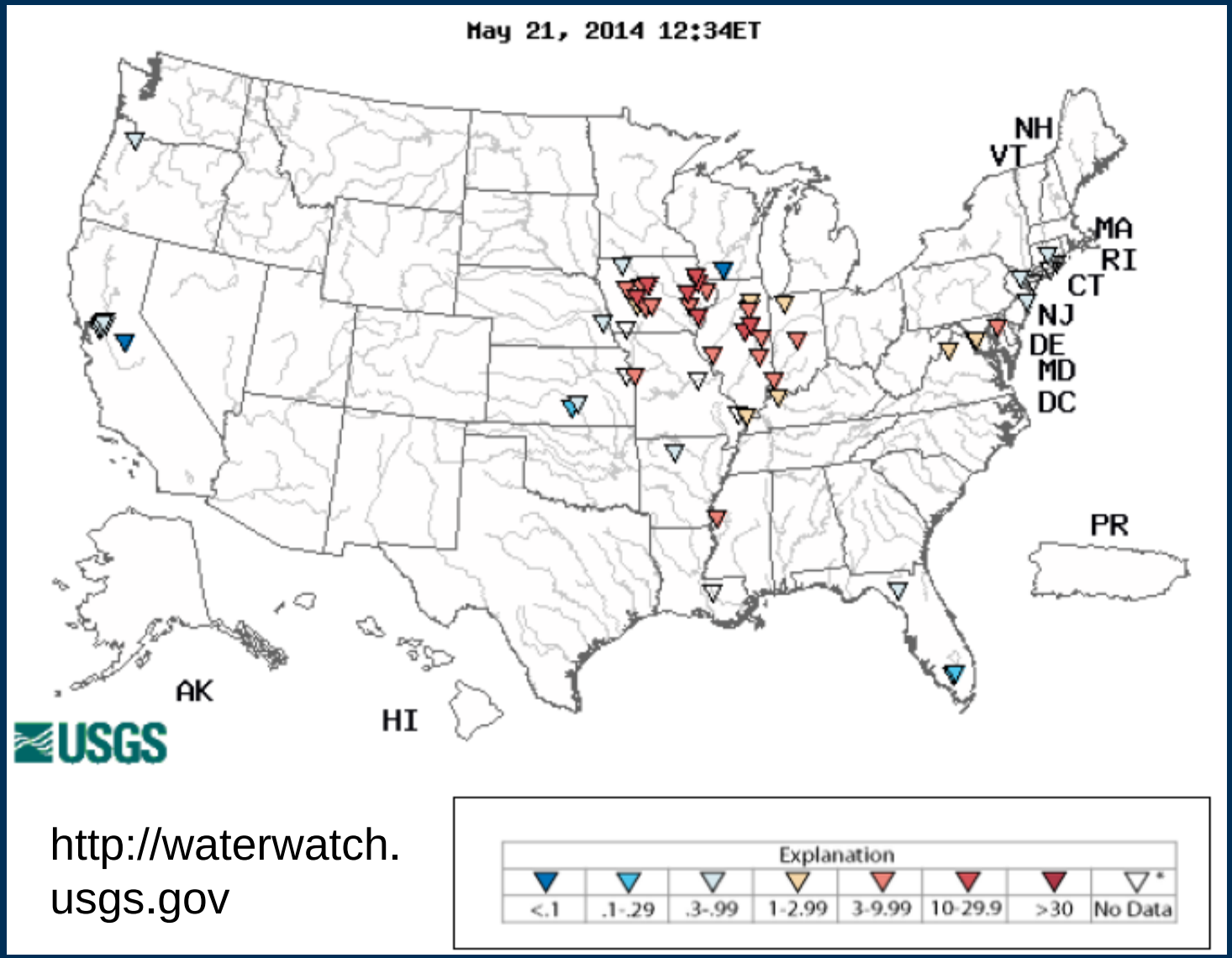
http: pubs.water.usgs.gov



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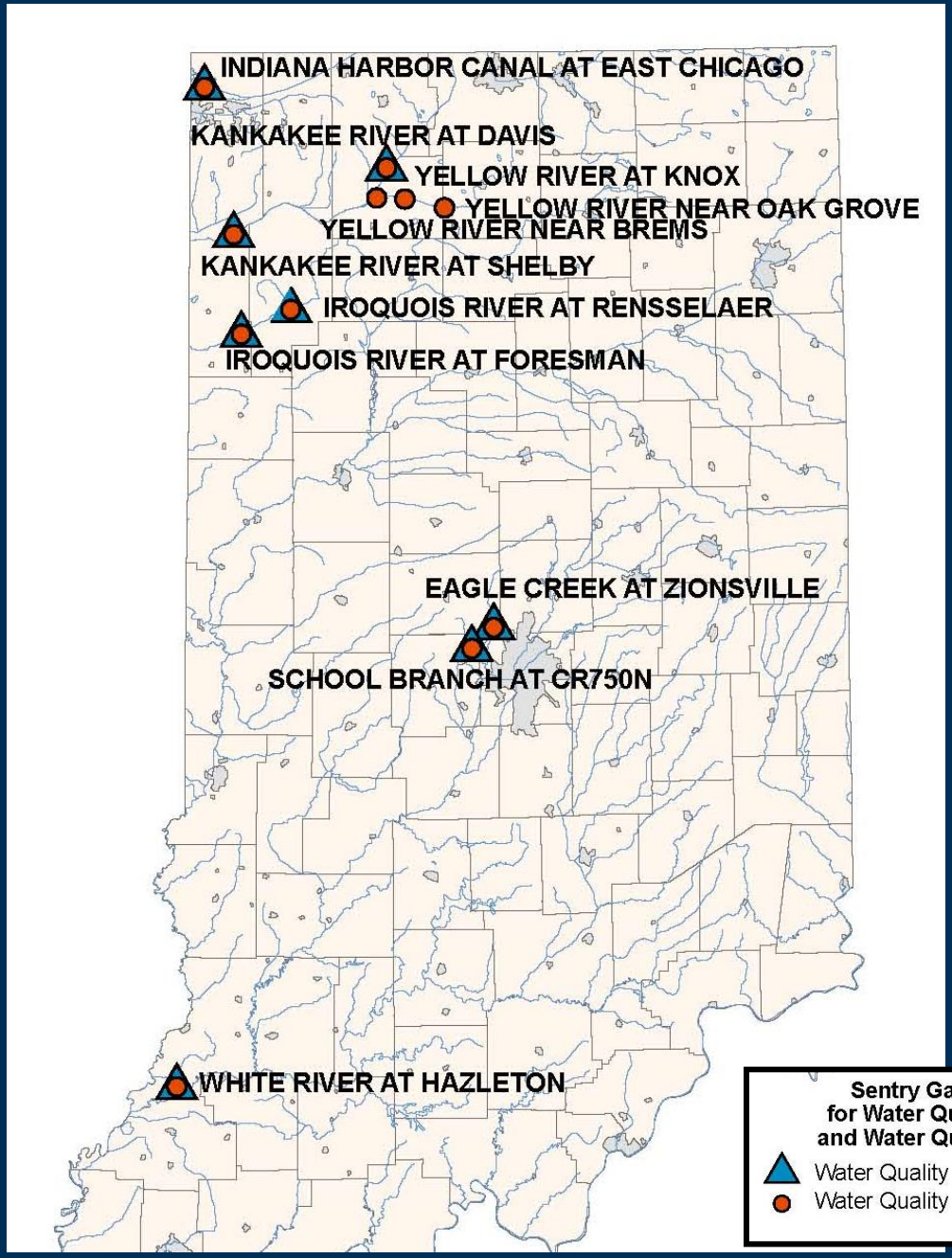
USGS Real Time Nitrate

Indiana Sentry Gage Network:
7 active gages
5 proposed gages



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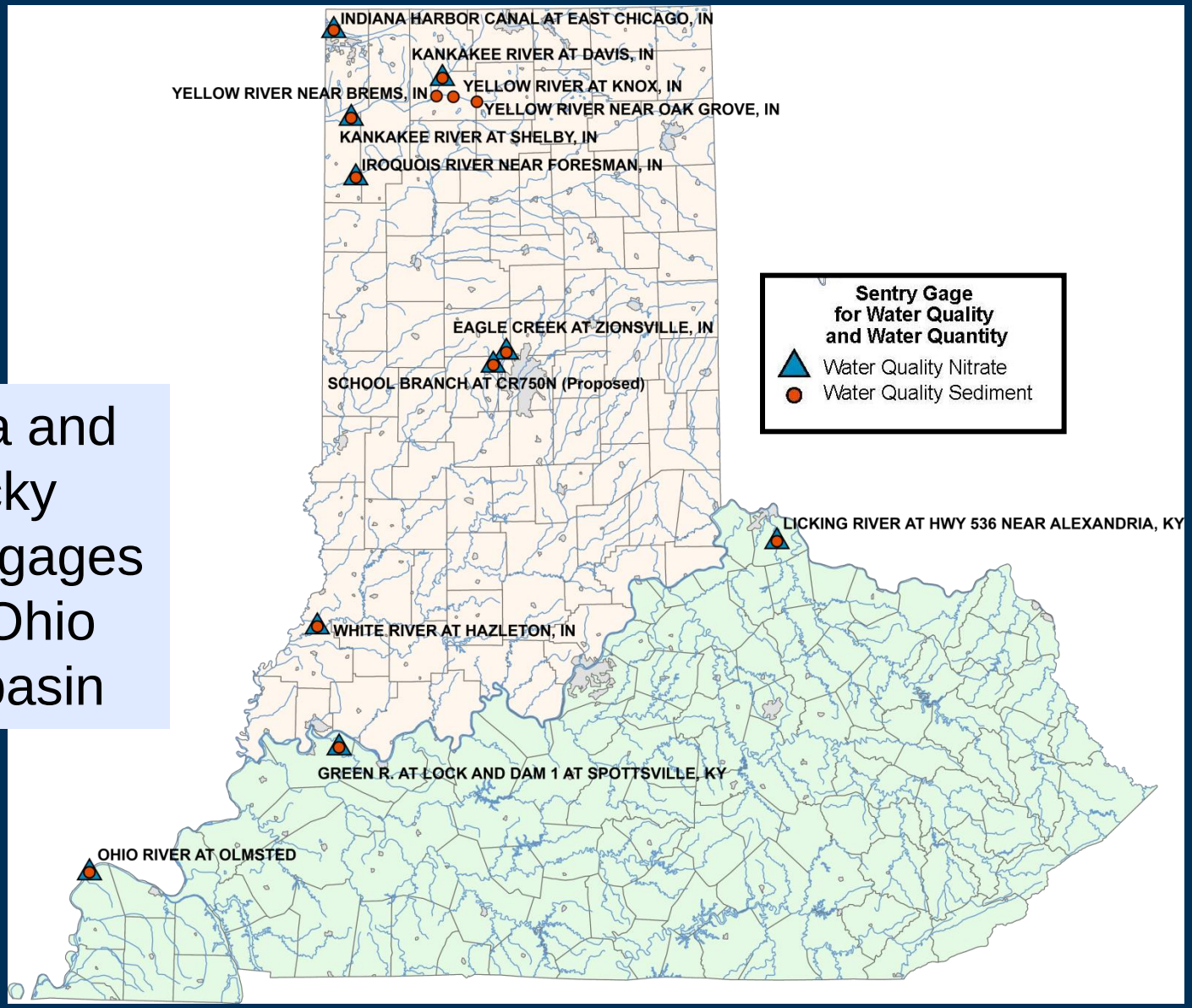
Indiana and Kentucky sentry gages in the Ohio River basin



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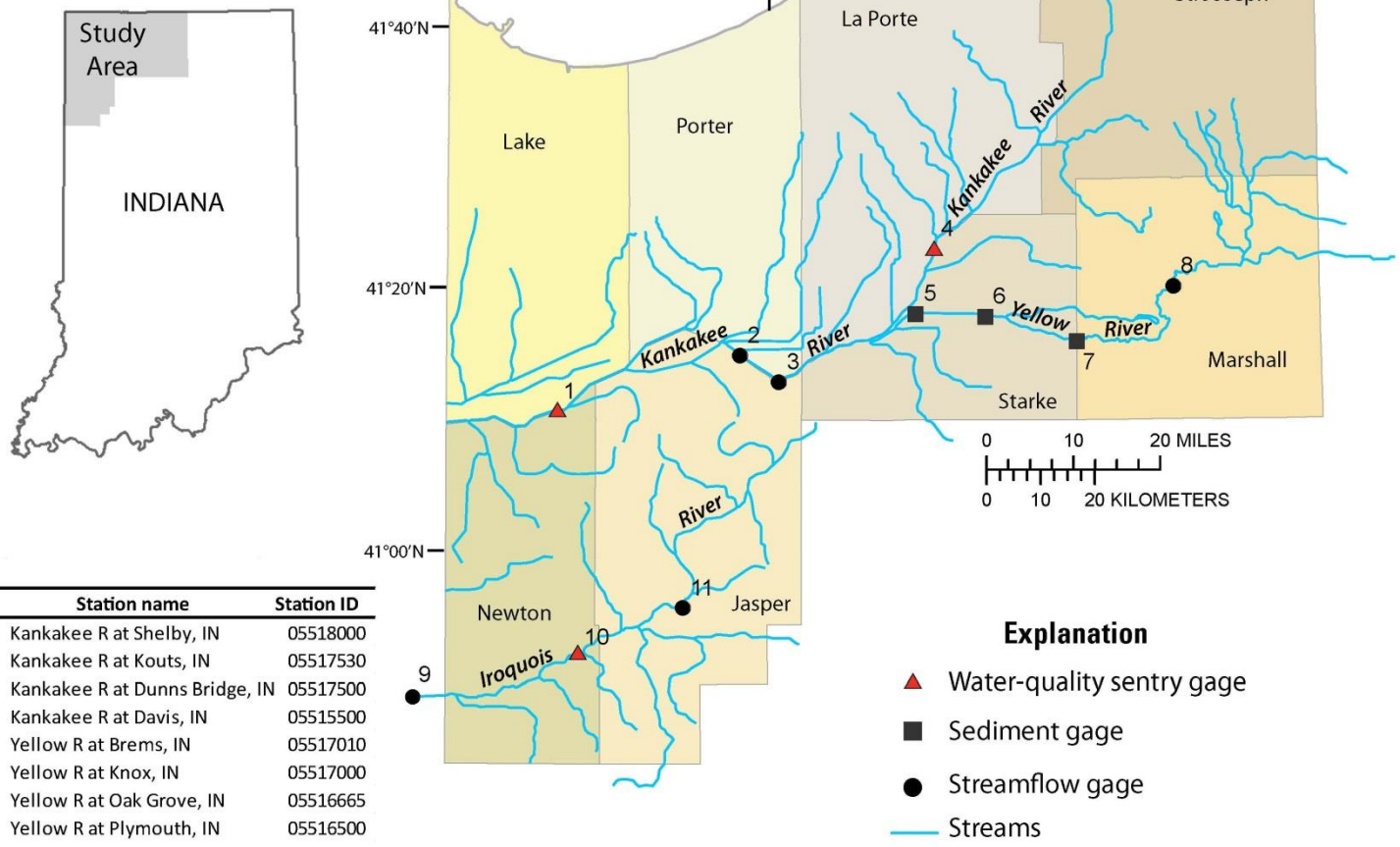
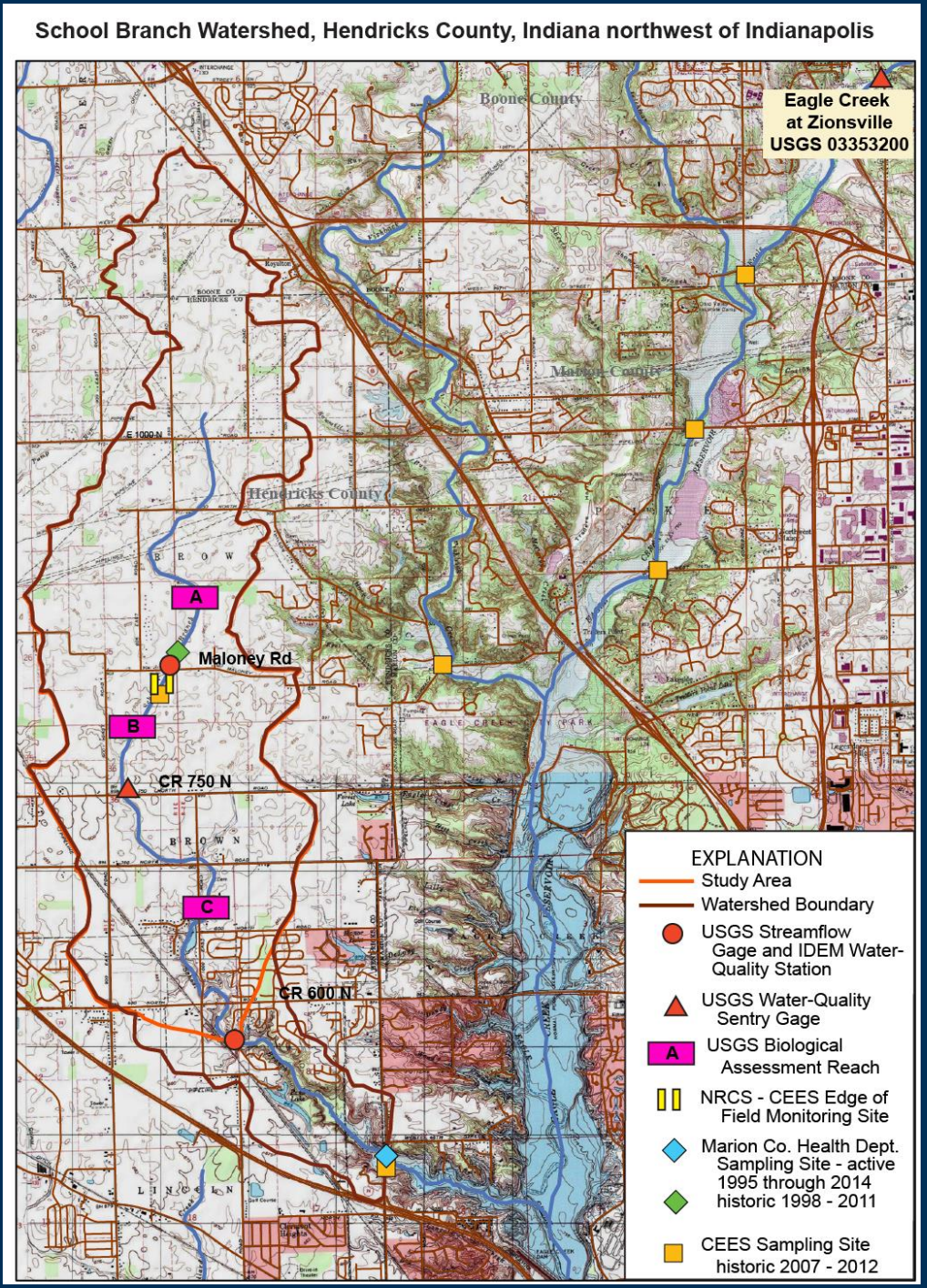


Map ID	Station name	Station ID
1	Kankakee R at Shelby, IN	05518000
2	Kankakee R at Kouts, IN	05517530
3	Kankakee R at Dunns Bridge, IN	05517500
4	Kankakee R at Davis, IN	05515500
5	Yellow R at Brems, IN	05517010
6	Yellow R at Knox, IN	05517000
7	Yellow R at Oak Grove, IN	05516665
8	Yellow R at Plymouth, IN	05516500
9	Iroquois R at Iroquois, IL	05525000
10	Iroquois R at Foresman, IN	05524500
11	Iroquois R at Rennelaer, IN	05522500

Indiana sentry gages and stream gages in the Illinois River basin

Investigation of Water Quality and Water Quantity in School Branch Watershed, Hendricks County



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